4/PRTS

Self-Locking Fastening Device

The present invention is relating to a self-locking fastening device comprising a screw or nut for fastening at least one first member to a second member, wherein the fastening device is comprising a washer provided with a central bore hole which on the surfaces thereof is comprising means which are fixed within or to the surfaces of the first member and the screw or nut during the tightening of the fastening device such that a self-actuated unscrewing is prevented.

Such a self-locking fastening device comprising a washer ribbed on both sides already is known from the EP 426 895 B1.

The self-locking fastening device disclosed therein is acting as well as the self-locking screws described in the DE 2556985 C2 as an effective safety device only as long as a sufficient pretension is prevailing in the screw connection. In case the connection due to extreme settling is loosing its pretension, then there is no locking against untightening anymore. Since the necessity of securing predominantly is existing in connection with short screws having a small clamping length, the danger of untightening is large because the elastic elongation of the screw in connection with a small clamping length is small, too. In such cases already settling amounts of a very few tenth of millimeters can lead to the loss of the pretension and therefore to the danger of a self-actuated unscrewing of the screw connection.

It is therefore the task to be solved by the present invention to improve a self-locking fastening device according to EP 426895 B1 in such a way that the amount of settling which can be compensated is substantially larger and therefore the danger of the loss of the pretension is becoming substantially smaller.

According to the invention, this task is solved by the feature that the washer is resilient in such a way that it can be compressed against its spring force during the tightening of the fastening device.

In this connection it is especially preferred that the washer is cambered in the radial direction, wherein the concave side is facing the member and the convex side is facing the screw-head or the nut, respectively. In this way, a spring force of the washer as large as possible is obtained.

Further, it is preferred that the washer only is cambered in the exterior marginal area in a radial direction while the inner part is flat. In this way due to the flat inner support it is ensured that even with larger losses of pretension the ribs of the upper side of the washer over the entire length of the support of the screw are maintaining the contact with the screw head. On the bottom side of the washer, this is not absolutely necessary since due to the very large friction radius even with the springing of the washer in the opening direction a sufficient locking action is maintained.

Optimal spring characteristics in this connection are obtained if the exterior cambered marginal area only is extending over the half of the width of the washer between the inner bore hole and the exterior margin.

Preferably as means for preventing a self-actuated unscrewing there are provided rib profiles. These can be most simply manufactured and are having a large efficiency.

For saving material and expenditure in manufacture, in this connection it is preferred that the rib profiles on the surface facing the screw or the nut only are provided in the inner area close to the bore hole and on the surface facing the member only in the exterior area close to the exterior margin.

In this connection, it is especially preferred that the rib profiles only are extending over the half up to two thirds of the radial width of the washer.

In the following, the present invention is more detailly described with reference to the two embodiments shown in the drawings. In the drawings show:

Figure 1 a washer for a self-locking fastening device according to the invention in a cross-sectional view; and

Figure 2 a second embodiment for this washer in a cross-sectional view, too.

Figure 1 is showing a first embodiment of a washer according to the invention for a self-locking fastening device. The shim 10 is having the usual shape of a washer with a central bore hole 11 for passing a thread carrier (bolt, screw). Contrary to the usual washers this washer according to the invention is cambered over the radius from the interior to the exterior and is consisting of a sufficiently strongly resilient material.

In Figure 1, the shim 10 is shown in such a way that the head of a corresponding screw or a corresponding nut is positioned above the shim and the member to be fastened is positioned below the shim. In this way, the shim 10 is cambered convexly in the direction of the head of the screw or the nut and concavely in the direction to the member. The top side of the shim 10 which, in the practical use, is facing the screw head or the nut, is directly adjacent the central bore hole provided with a suitable rib profile 12 extending over about two thirds of the width of the shim.

In the same way, the bottom side of the shim 10 facing the member is provided, too, with a suitable rib profile extending from the exterior margin up to about the half of its width. Corresponding rib profiles for example are known from

the EP 426895 B1 or DE 2556985 C2 and therefore do not need to be more detailly described here.

Figure 2 is showing a further embodiment of a washer 10' according to the invention for a self-locking fastening device, wherein the shim 10' in its inner region is performed flat up to a about the half of the width of the shim 10' and only thereafter radially further outwardly the camber of the shim is beginning. Again on the top side of the shim 10' facing the screw head or the nut, respectively, there is provided a suitable rib profile 12' only in the flat area while on the bottom side of the shim 10' facing the member the rib profile 14' merely is provided in the exterior cambered area.

The function of the self-locking fastening device with these washers 10, 10' according to the invention is improved such that the washers 10, 10' during the tightening of the fastening device are pressed into a flat configuration against the spring action of the material of the washers 10, 10'. Doing so, the rib profiles 12, 14, 12', 14' as for example shown in the EP 426895 B1 are embedded in the material of the screw head or the nut, respectively, and the workpiece. In this way, the fastening device is secured against a self-actuated untightening since a friction being too large would have to be overcome.

In case the connection should be settling the washer 10, 10' according to the invention again (partly) is springing in the opening direction and the rib profiles 12, 14, 12', 14' in spite of the settling are still pressed with the sufficient force against the screw head or the nut, respectively, as well as against the member. In spite of a corresponding settling, the security against a self-actuated unscrewing is maintained.

For the present invention, it is of extreme advantage if the spring force of the shim is as large as possible. It is however not absolutely necessary to emboss the rib profile on the entire top face and bottom face of the shim. It is all

together sufficient to provide the top side from the bore hole 10 to the exterior diameter about two thirds of the shim support with ribs 12. On the bottom side, it is sufficient to provide the half of the support length on the exterior diameter in the direction of the bore hole 10 with ribs 14 as this is shown in Figure 1. Naturally the shim according to the invention is functioning, too, if the ribs are provided over the entire top side and bottom side of the shim in a way corresponding to the flat disk according to the EP 426895 provided on both sides with ribs. The expenditure necessary to this end however partly can be saved.

The embodiment according to Figure 2 is ensuring that with a larger loss of pretension that the ribs 12' on the top side of the shim due to the flat inner support at the screw head or at the nut, respectively, still are remaining in contact over the entire length of the support of the screw or nut, respectively, with the screw head or the nut, respectively. At the bottom side of the shim this is not absolutely necessary since due to the very large friction radius even with the springing of the shim 10' in an opening direction a sufficient safety action is maintained.

Material and heat treatment of the washer according to the invention can be used and performed in the same way as with the disk according to the EP 526895 B1 with ribs on both sides.